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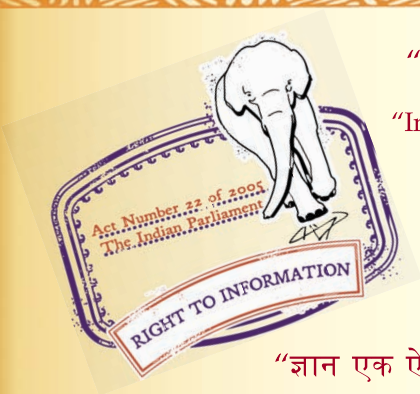
IS 9001-19 (2006): Guidance for environmental testing, Part 19: Salt Mist test [LITD 1: Environmental Testing Procedure]



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भारतीय मानक

पर्यावरण परीक्षणों के लिए मार्गदर्शिका

भाग 19 सात्ट मिस्ट परीक्षण

Indian Standard

GUIDANCE FOR ENVIRONMENTAL TESTING

PART 19 SALT MIST TEST

ICS 19.040

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

September 2006 **Price Group 2**

Environmental Testing Procedures Sectional Committee, LTD 02

FOREWORD

This Indian Standard (Part 19) was adopted by the Bureau of Indian Standards, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Information Technology Division Council.

This standard covers the guidance details for salt mist test. The test procedure of salt mist test is covered in IS 9000 (Part 11) : 1983 'Basic environmental testing procedures for electronic and electrical items: Part 11 Salt mist test'.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the results of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*).' The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GUIDANCE FOR ENVIRONMENTAL TESTING

PART 19 SALT MIST TEST

1 SCOPE

This standard (Part 19) deals with the guidance details of the test for salt mist on electrical and electronic items.

2 APPLICABILITY OF TEST

Salt mist tests are conducted mainly to:

a) select the most suitable material (or protective coating) for a certain environment such as marine climate;

b) determine the environments in which a given material may be used satisfactorily;

c) develop new alloys for specified purpose;

d) serve as a control test for uniformity of resistance of materials under certain conditions, as in making corrosion resisting materials; and

e) predict the functioning of equipment or components under corrosive conditions.

3 FACTORS INFLUENCING CORROSION

3.1 Important factors which influence the corrosion under conditions of usage are:

a) Climate, for example, marine, rural, urban, industrial and tropical climates and combinations thereof;

b) Irregular variation in each climate from place to place and also at the same place, not only with the seasons, but from year to year, day to day and even from hour to hour;

c) Exposure conditions, for example, outdoors (under shelter) or in the open field;

d) Polluting substance occasionally present in the atmosphere, for example, dust and soot particles, corrosive gases other than the one normally present in that particular climate; and

e) Position of test item, for example, the position of the surface, horizontal, vertical, etc, so that one surface of the material may be more corroded than other surface of the same material in the same equipment.

3.2 With the above variations in operating conditions, it is clearly impossible to have one general accelerated corrosion test for predicting the behaviour of a component or equipment under usage condition. A better approximation may be obtained by using different tests for different climates; for example:

Marine climates	:	Salt mist and salt spray
Tropical climates	:	Air with high relative humidity and condensation
Industrial/Urban climates	:	Humid air with sulphur dioxide

4 ACCELERATING THE CORROSION PROCESS

4.1 To get the desired information in short time, the corrosion process shall be accelerated. This is, done by changing some of the conditions of operation. The most usual changes are:

a) Increasing the temperature (*see* **4.2**);

b) Increasing the relative humidity;

c) Increasing the extent of condensation (*see* **4.3**); and

d) Increasing the concentration of corrosive substances used for the test (*see* **4.4**).

4.2 Temperature

In general, as per Arrhenius relation, chemical reaction is accelerated by a factor of two for a temperature rise of 10°C. This is only true, if by increasing the temperature, no other rate determining factors change. Unfortunately many factors, which influence the corrosion rate may change with the temperature. A few examples are:

a) Solubility of gases in water decreases with the rising temperature. Under special conditions of condensation this might slow down the corrosion rate;

b) If under normal service conditions the corrosion products form a protective layer on a metal, this layer may not be formed at higher temperature, so that the corrosion rate increases tremendously;

c) If under normal service conditions a metal shows only a slow general attack; by higher temperatures other much more dangerous types of corrosion may occur, for example, pitting stress corrosion; and

d) If two noble metals are connected, the less noble one might cathodically protect the other, it is possible that by increasing the temperature the order

of nobility changes. As an example, iron is protected by the less noble metal zinc at room temperature but above 70°C zinc is more noble than iron and does not protect iron any more.

4.3 Condensation

If condensation occurs, the corrosion rate is generally much higher than without condensation. In most climates there are periods with a possibility of condensation. As a rule, increasing the extent of condensation will increase the corrosion rate. But there are several complications with condensation, in normal operating conditions and in accelerated tests, for example:

a) Only on a clean and finish smooth surface condensation never occurs before relative humidity of 100 percent is reached;

b) Just as rain, large amount of condensate can wash away hygroscopic products and may retard corrosion. Such retardation is very prominent in zinc. So instead of accelerating corrosion rate superfluous condensation may retard it. On the other hand condensate can fill gaps and cavities and keep surfaces wet for a long time, this may increase the corrosion rate at such places enormously; and

c) Heat capacity of an equipment or components is very important under varying temperature and humidity conditions. When the temperature of the atmosphere increases the temperature of the item will increase slowly. The difference will be large with a large heat capacity and it is possible that dew point of the surrounding atmosphere is higher than the temperature of the item, so that condensation may occur. But under the same circumstances on an item with a low heat capacity no condensation takes place.

4.4 Concentration of Corrosive Substances

Many different corrosive substances in the form of solids and gases are found in the atmosphere. For accelerated tests a choice shall be made. In general those substances are chosen which are known to be frequently present in the atmosphere, for example, sodium chloride in marine atmospheres, sulphur dioxide in urban atmosphere and industrial atmospheres.

5 EFFECTS OF SALT ON MATERIALS

5.1 The effects of salt on material almost always result from the combination of salt with another environmental factor. The two factors most commonly associated with salt are water and wind. Combinations of salt and water that occur in the atmosphere are precipitated in the form of rain, snow, fog and dew.

5.2 Metals

5.2.1 The principal effect of salt is its corrosive effect on metals. Although metal corrosion occurs in the absence of salt but salts greatly accelerate both chemical and electro-chemical corrosion and moreover presence of sufficient moisture always produce these effects.

5.2.2 A salt may contribute to the corrosion of metal in two general processes. It may serve simply as neutral electrolyte for conduction of electronic current or it may ionize in water to form a slightly acid or slightly alkaline solution in which case the free acid or alkali can react chemically with the metal. Both the electrolytic and chemical actions may occur simultaneously.

5.2.3 Analyses of metal corrosion in sea water show that steel is corroded more rapidly by occasional salt spray than by total immersion in salt water, while brass is corroded more rapidly by total immersion than by occasional spray.

5.2.4 The combinations of materials used in components and assemblies is a major factor in corrosion. Of the many types of corrosion that a marine environment encourages, the galvanic and crevice types are probably the most common and most severe. Salt mist greatly intensifies the galvanic interaction between different metals as compared with their performance in fresh water. Shapes and joints that provide crevices into which oxygen does not have ready access may also set up a corrosion cell between areas of low and high oxygen concentration in the crevices. In general, the wider the separation of metals in the galvanic series, the greater the probability of corrosion.

5.2.5 There is a strong relation between mechanical stress which produce cracks or changes in surface structures of metals and the effect of salt. The onset of stress corrosion is greatly accelerated by salt. The position of the metal in the galvanic series should be considered in the prediction of combined effects involving salt.

5.3 Paints

In films of paint over metal, salt aggravates corrosion and film breaks down by increasing electrical conductivity (which favour formulation of local electro-chemical cells) providing the development of alkalinity at cathodic areas (by virtue of high sodium content), facilitating steep gradients in ion concentration (which encourages osmosis through coating films), and destroying metal passivity (owing to high concentration of chloride ions). Paint blistering is probably the result of a combination of electrolysis and osmosis. Formation of alkali at cathodic areas, increased diffusion by virtue of ion concentration gradient and the resulting internal osmotic pressure together result in blisters and the alkali that is produced further degrades the films by direct chemical attack.

5.4 Electrical Equipment

Electrical equipment may be affected by salt. Salt mist can impair insulators of OH line by depositing minute salt particles on their surfaces. Salt mist impairs electrical equipment by depositing the salt on the surface of insulants where it produces conductive coatings and causes or accelerates corrosion of insulating materials and metals. At relative humidity (RH) over 75 percent, the coating surfaces become strongly conductive and may cause problems.

5.5 Mechanical Equipment

Salt deposits or corrosion resulting from the salt may result in clogging or binding of moving parts of mechanical components and assemblies. High winds causing sand, dust and salt particles in dry areas may cause external abrasion of material, thus accelerating corrosion process by removing protective surfaces and coatings.

6 CORROSION PROTECTION

6.1 Protection Through Design

6.1.1 It is essential that the corrosion-resistant materials that satisfy the strength, weight and other mechanical, metallurgical and economic requirements be selected. The use of dissimilar metals should be avoided wherever practicable; when this cannot be avoided, the metals selected should be as close together as possible in galvanic series. Combinations should be avoided, in which area of the less noble metal is relatively small, also the more noble materials should be used for key components. Dissimilar metals should be electrically insulated wherever practicable and spaced as far apart as possible. If complete insulation cannot be achieved, the use of high dielectric spacers, paint, plastic coating, tape or other material at the joints to increase the electrochemical circuit resistance is helpful. Precautions should be taken to issue against water traps in which salt mist can be trapped. Free drainage should be provided.

6.1.2 In spite of corrosion protection efforts, some amount of corrosion takes place in most items of equipment. Parts which are subjected to corrosion to a large extent, should be designed to be easily accessible for inspection and treatment.

6.2 Protection by Coatings and Surface Treatment

6.2.1 The most common methods for prevention of corrosion are coating of surface with a layer of suitable material, chemically treating the surface, and covering with a porcelain, ceramic, or organic coating.

6.2.2 The most frequently used plating materials on iron and steel are cadmium, zinc, nickel, chromium, tin and lead. Under most conditions, both cadmium and zinc are less noble than steel and therefore are used for galvanic protection. Since nickel coating is more noble than iron and steel, protection is afforded only by using the coating as an impervious barrier.

6.2.3 Chemical conversion treatment for metals usually are applied by dipping that causes a non-metallic coating to be deposited on the surface. Such treatments reduce the probability of the base metal entering into a galvanic couple and provide a controlled, roughened base for painting.

6.2.4 Protection provided by a paint coating is due to its ability to act as a mechanical barrier, thus preventing the corrosive medium from reacting the metal surface. The first coating is generally a primer that promotes maximum adhesion to the surface and provide inhibitive and continuing passivating effects. The paint coating or coating applied over primer provide the barrier.

7 CONCLUSION

7.1 It is impossible to predict the behaviour of a material, component or equipment from the result of one general corrosion test, or from a few tests adapted to represent different climates.

7.2 Corrosion tests are very useful and necessary to check the quality of a particular material or surface coating, provided that test suitable for the material under consideration is chosen.

7.3 Testing combination of different materials may be necessary to determine, if one material influences the corrosion behaviour of the other material. A suitable test for material has to be chosen and the results will be compared with the behaviour of the material when not in combination with others. In many cases humidity test is sufficient. But there are few important cases where the humidity test has to be supplemented by more specialized procedure.

7.4 Testing of an equipment or component may be necessary to check, if the functioning of the specimen is influenced by corrosion products or if the functioning influence the corrosion behaviour of more materials. A suitable test is again very important. In this case, the functioning of the specimen is generally more important than the appearance affected by the test.

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Review of Indian Standards

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